# 10 Issues in Urban Stormwater Pollution Control

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*As pollution from traditional point sources is reduced, it is clear that much of the remaining pollution in most rivers, lakes and streams is the result of stormwater discharges from urban systems. Municipalities are adapting a variety of stormwater management practices to counteract the problem.*

Water pollution control in the United States has not always moved forward in a logical or predictable pattern. But the signs are clear that cities and counties are increasingly responsible for controlling pollution from stormwater. The public's interest in protecting natural resources, as well as state and federal legislation and regulation, ensures that cities and counties must face up to those responsibilities. But before they can do so, public works administrators must answer a number of questions about stormwater pollution, including: Is it really a problem? What regulations and requirements must be met? What tools are available to reduce stormwater pollution? How much will it cost and who should pay?

Prior to the 1972 passage of the Clean Water Act (CWA), interest had been focused primarily on minimizing pollution from point discharges of municipal or industrial wastewater. The requirements for discharge permits through NPDES, along with the mandate that all municipal wastewater, with limited exceptions, receive at least a secondary level of treatment resulted in a dramatic reduction in pollution loading to the nation's waters and a corresponding improvement in water quality.

One study indicates that the number of persons served by publicly-owned wastewater treatment plants in the United States increased from 140 million in 1972 to 170 million in 1992. Over that same period, the number of tons of BODS, a measure of total organic content in wastewater, discharged from these plants decreased from 7,500 tons per day to 3,500 tons per day. In other words, per capita pollution loadings decreased by more than 60 percent over that 20-year period.

As pollution from "traditional" point sources is reduced, it is clear that the remaining pollution in most rivers, lakes and streams is the result of stormwater discharges from urban systems and nonpoint runoff from agricultural sources, including sediment from eroded land, fertilizers, pesticides, plant residues and animal wastes. Depending on geographical location and types of agricultural activities, the pollution from these sources may equal or exceed that from urban sources. Indeed, many programs are in place at federal and state levels to address agricultural pollution.

The CWA contained provisions for addressing pollution from urban stormwater discharges, but it was not until municipal and industrial wastewater systems were upgraded that the attention turned to stormwater discharges. Phase I of the stormwater NPDES program began in 1987 and required cities and counties with systems serving more that 100,000 persons to complete NPDES permit applications.

The major elements of these permit applications were to define the systems and discharges to the systems, including illicit industrial discharges, to formulate monitoring programs that would define the amount of pollutants conveyed by a system and to propose "Best Management Practices" (BMPs) for reducing the pollution.

These large cities were required to complete their permit applications by 1992, with a five-year renewal required in 1997. Current regulations leave those cities and counties serving fewer than 100,000 people in regulatory limbo. The U.S. Environmental Protection Agency (EPA) was to have issued Phase II regulations covering those systems by October 1992 but missed the deadline. Various proposed revisions to the CWA have addressed requirements for these Phase II systems, but none has passed Congress.

Meanwhile, in August 1995, EPA issued a final stormwater rule that extended the deadline for permitting systems serving under 100,000 residents to 2001.

**Sources of Urban Stormwater Pollution**

The urban environment and its supporting activities and infrastructure respond to rainfall in a variety of ways. The rain runs off residential yards typically carrying fertilizers, pesticides, and yard wastes runoff from streets carries dust, heavy metals, oil and grease.

Runoff from commercial and industrial areas conveys a variety of pollutants associated with the activities in these areas. In all urban areas, but particularly where construction is taking place, heavy loads of sediment are washed from the soil stripped of its natural vegetative cover. The runoff and the pollutants it carries are usually conveyed through a system of underground pipes and above-ground open channels until it discharges to a natural stream. Some cities have combined sewer systems designed to carry both domestic wastewater and stormwater. When stormwater flows are large, these combined systems are usually designed to overflow to the natural streams at certain locations.

The Combined Sewer Overflows (CSOs) carry a mixture of wastewater and stormwater and have been recognized as a significant source of pollution. EPA recently issued a set of nine minimum controls that cities with combined systems are to implement by January 1997.

And, even systems designed with separate conveyances for stormwater and wastewater are frequently subject to overflows from the wastewater system. These Sanitary Sewer Overflows (SSOs) are usually caused by leaky systems that allow large amounts of unintentional inflow or infiltration. EPA and many state environmental agencies have cited wet weather discharges as a major cause of water quality impairment and worthy of special attention.

**Current Regulatory Initiatives**

Revisions to the CWA have been proposed by various members and committees of Congress periodically over the last several years. With the current focus on presidential and congressional elections, very little is expected to happen on re-authorization during this session of Congress.

However, another significant activity on the stormwater front is being spearheaded by EPA, which has established a Federal Advisory Committee on Urban Wet Weather Flows and subcommittees addressing Ssos and the Phase II stormwater program.

These groups are to comprehensively review federal stormwater programs and recommend measures to improve the overall effectiveness of the programs. The Urban Wet Weather Flows Advisory Committee includes representatives of business and industry, county and regional governments, environmental organizations, municipalities, commercial interests depending on natural resources, recreational interests, state agencies and technical or academic institutions.

The activities of these groups are being coordinated by EPA and specialty consultants with skills in facilitation. An earlier facilitate effort led to EPA adoption of the CSO policy that includes the nine minimum controls. Several clear issues can be discerned within the broader currents of storrnwater pollution control.

**1) The watershed is the unit of planning.** Despite the inherent logic of planning on a watershed basis, many plans have been and will be developed based on some other boundaries- usually political. While geographic limits of responsibilities and funding must be respected in the implementation of plans, the natural hydrologic units are the only foundation for successful comprehensive stormwater pollution control efforts. All pending attempts to reauthorize the CWA include provisions for planning on a watershed basis.

The versions of the Safe Drinking Water Act recently passed by both the House and the Senate contain provisions for protection of drinking water sources on a watershed basis. Watersheds will be the focal unit of planning as evidenced by the legislation, regulations and interest throughout the professional community. Indeed, the Watershed 1996 Conference sponsored by the Water Environment Federation this past June drew over 2,000 attendees.

Computer modeling was used to help evaluate the effectiveness of BMPs in controlling nonpoint source loadings to watersheds in North Carolina. The Honeycutt and Lower Barton's creeks discharge into Falls Lake, the water supply for the Raleigh, N.C. and most of Wake County.

Annual pollutant loadings from the watersheds were estimated for existing, current zoning build-out and three future development plans. The structural BMPs were evaluated for effectiveness in improving water quality in the watersheds, ease of implementation, operation and maintenance requirements and costs.

**2) Public involvement is essential.** To become effective, stormwater pollution control starts with the support and cooperation of those living in the watershed.

Community involvement has been a key element in many successful stream cleanup efforts. Examples include "stream teams" that organize local volunteer units to periodically gather trash and debris from urban streams, environmental science classes from local high schools and colleges that voluntarily monitor stream quality, programs to label storm drains so that waste products such as pesticides and used motor oil are not dumped in them and local businesses to help sponsor activities.

Public awareness of the holistic nature of water and watersheds leads people to better decisions on stewardship, and this, in turn, leads to more prudent use of lawn and garden care products and more conscientious disposal of waste products by the public.

**3) It all starts with erosion control.** By far the most significant urban stormwater contaminant is sediment. Not only is it aesthetically displeasing, but concentrations of other pollutants can be frequently associated with the concentrations of sediment.

Construction activities are the chief culprit in increased sediment; places where the natural vegetative cover has been removed and bare soil is subject to the full erosive force of rainfall and runoff.

Effective erosion control activities at construction sites, such as erosion fences and mulch soil covers, are broadly practiced, and most cities and counties enforce effective erosion control ordinances.

**4) Urban habitat must be protected.** "Many urban stream corridors have been abused and neglected," says Steve John, president of Environmental Planning and Economics and a member of Spiderweb, a coalition of government agencies and environmental groups working to create a river greenway in Decatur, Ill.

"Restoring them as public treasures requires attention to water quality, to restoration of aquatic and riparian habitats and to land use and recreation opportunities, and stormwater or CSO planning should integrate all three elements."

It has long been recognized that the overall water quality of urban streams can be measured by the vitality and diversity of animal and plant life supported by the riparian system. If the stream supports a healthy population of fish and other species, it is more likely to be safe for human contact.

Conversely, there is also increasing recognition that the first flush of urban runoff frequently has relatively minor impact on habitat values, as many types of biota can survive short periods of impaired water quality but are much more sensitive to the overall long-term, chronic water quality in their aquatic ecosystem.

**5) The most cost-effective technologies must be used.** Many measures are available for controlling urban stormwater pollution. The most cost-effective usually focus on preventing the contaminants from ever entering the storm drainage system.

Examples are household waste disposal centers, periodic street sweeping and erosion control at construction sites.

In some cases, stormwater conveyance and detention facilities can be retrofitted with flow control structures to enhance their performance for pollution control, either as wet or dry detention basins or as constructed wetlands.

Also, particularly in addressing CSOs, a significant amount of pollutants can be removed from stormwater by use of relatively cost-effective engineered facilities such as vortex separators or specially configured screens.

**6) Stormwater may eventually become drinking water.** The old school of thought was the protection of urban streams and rivers from contamination was needed for aesthetics. Today, however, some cities in the arid Southwest have built drainage detention facilities as basins for recharge of groundwater which serves as the source of potable supply. Many metropolitan draw raw water supplies from lakes or canals that receive runoff from surrounding upstream or urban areas.

The American Water Works Association, which represents major public water suppliers throughout United States, Canada and Mexico, recently invited a group of experts to address technical issues and legislation focused exclusively on protection of sources of supply.

**7) The use of natural systems will grow.** While urban drainage systems have typically included large amounts of concrete, steel and asphalt, new systems are being designed and constructed with a greater reliance on natural processes. Constructed wetlands and riparian buffer zones are often built to remove pollutants or prevent them from entering the watercourse.

Also, many communities turned to the use of specifically constructed vegetative erosion control facilities to line and protect stream channels. The natural systems also provide habitat value and are much more aesthetically pleasing than traditional concrete-lined channels.

The Ramsey Lake Constructed Wetland in Portland, Ore., will treat stormwater runoff from industrial and residential areas that recently had their sewer system separated.

Stormwater can go directly into the nearby Columbia Slough after going through the wetland, thus adding capacity to the remaining combined sewer system.

"The new wetland helps our sewer system and enhances wildlife habitat," says Dean Marriott, director of Portland's Environmental Services Department. "It has also been an excellent way to teach school groups about pollution prevention, and students have helped with water quality monitoring.

8) **Geographic Information Systems (GIS) will serve as the foundation of many communities' stormwater management plans in the future.** Progressive cities have GIS in place and are continually updating the data within these systems.

At the most basic level, the GIS provides an accurate and easily accessible repository for physical data, including locations, elevations, dimensions, materials and dates of construction associated with an urban storm drainage system.

It can also include all of the information about the watershed, such as slope and land use, that relates to estimating runoff and can streamline computer modeling efforts.

GIS is increasingly being used as an operations and maintenance tool to store data such as locations of complaints and maintenance records for facilities, and it can also be used to prepare exhibits and data for public relations purposes.

**9) Control of stormwater pollution may be traded for upgrades at wastewater treatment facilities.** As long as the level of pollution in a stream is kept low, it may not matter which source pollutants are removed from stormwater, runoff or wastewater treatment facilities.

In many urban environments, wastewater treatment plants have been designed and constructed for secondary treatment. Upgrading these plants to advanced treatment levels can oftentimes become extremely expensive, and it may be more cost-effective to implement BMPs to control storm-water pollution within a watershed as opposed to developing advanced treatment facilities at specific point source locations.

EPA recently released a "Draft Framework for Watershed-based Trading" to help and encourage such cost-effective and creative solutions to water pollution control.

The framework provides for several combinations of point-point, point-nonpoint and nonpoint-non-point source trading.

Although each potential for effluent trading must be viewed in the context of the individual situation, city and county planners and engineers should consider such trades as means to stretch available public funds. For example, Phase I of the Tar-Pamlico Basin in North Carolina, begun in 1989 and completed in 1994, set interim goals and established a framework for nutrient reduction trading and included monitoring and modeling. Phase II will apply the results of the first phase to reach long-term goals established through 2004. Most controllable nitrogen and phosphorous loads come from agricultural nonpoint sources such as livestock and crops.

At Tar-Pamlico, extensive improvements in treatment at point sources were estimated to cost somewhere between $250 per kilogram and $500 per kilogram, reduced while nonpoint-source reductions were priced at $56 per kilogram for members and $62 per kilogram for nonmember point sources.

This ambitious basin-wide strategy worked and reduced overall nutrient loading while average flows to receiving waters increased.

Responsibility for nutrient load reductions is allocated among association's members who can receive nutrient credits (allowances) if they are able to reduce nutrient discharge below their allocations.

These credits can be traded with other members or saved for future use. Meeting the goal of reducing nutrients by 200,000 kilograms per year exclusively with point-source control is estimated to cost between $50 million and $100 million.

Achieving the same reduction entirely through funding nonpoint-source controls costs approximately $11.2 million.

Buffer strips around waterways to remove nutrients, no-till to minimize runoff from fields and holding ponds to prevent animal wastes from being washed directly into waterways can be effective solutions.

**10) Stormwater pollution control can be financed by user fees.** According to the most recent comprehensive survey of stormwater utilities conducted, user fees provide the major source of income for 78 percent of the responding utilities.

For many years, the trend in financing public services has moved away from general funds and toward service charges, and this trend is expected to continue.

Although most of the stormwater user fee systems in place are formulated to recover costs associated with some measure of stormwater runoff quantity, 26 percent of the respondents indicate that user fee credits or other incentives are provided to encourage customers to control or reduce stormwater pollution.

The survey also indicates that 11 percent of the utilities have user fees specifically designed to provide for the separate recognition and equitable recovery of costs associated with both stormwater quality management and stormwater quantity management.

While many communities have been fearful of the potential for federally mandated control of stormwater pollution, the ongoing revolution in thinking about watersheds and their uses in the urban setting offers the opportunity for new and creative approaches to improving the quality of stormwater runoff.

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